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FINAL REPORT
PHASE II

P. Kovacs, R.L. Perez, W.W. Whyte

Teledyne Geotech
314 Montgomery Street
Alexandria, Virginia 22314-1581

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Programs to support the collection and processing of the seismic data were improved and enhanced. A control system for the Center software was implemented so that formal procedures to maintain the software could be imposed. A commercial version of INGRES was purchased after comparing it with the version obtained from the University of California at Berkeley.

ABSTRACT

This report summarizes the activities at the Center for Seismic Studies for phase II, covering the period of February 1, 1983 through January 31, 1984, of a three-phase contract. Real-time data from the Regional Seismic Test Network (RSTN) were routinely recorded during the first quarter of the period. Data from the Global Digital Seismic Network (GDSN) and the Seismic Research Observatories (SRO) were formatted and archived along with data from several other sources. Databases were developed using the commercial INGRES relational database system to provide users access to event, arrival, and waveform data.

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INTRODUCTION

This final report summarizes the work performed at the Center For Seismic Studies in Rosslyn, Virginia, during the period February 1, 1983, through January 31, 1984. The activities described here were accomplished under Contract MDA903-82-C-0063, and this report fulfills Data Item 0002AG of the Report Requirements in that contract.

The objectives of this contract were 1) operate the Seismic Data Center (SDC) routinely for subsystem debugging purposes; 2) continue development support for the data management and seismic data analysis portions of the SDC; and 3) begin to operate the SDC in support of other Defense Advanced Research Projects Agency (DARPA) research and studies.

During this contract period we operated the Center on a routine basis. Section II discusses the development of the databases and the formatting and archiving of seismic data. Also discussed are tests to enable the center to participate in international experiments for exchanging data. In Section III, we discuss computer system upgrades and improving communications to the computer systems. Software development is reported in Section IV. In this section we discuss the improvements and enhancements to the database and seismic applications software. Also discussed is the creation of a software control system for Center software.

DATA BASE DEVELOPMENT

The operations staff continued archiving GDSN and SRO data. This effort proceeded at a rate of 15 to 20 GDSN tapes a night. Data for five to six days fit on one tape in the Center's data format at the density of 6250 bpi. In all, GDSN data for the period beginning in 1980 through April 1983 were recorded on tape. The archiving of the SRO day tapes, the forerunners of the GDSN's tapes (1976 to 1980), was accomplished by August.

No tapes were recorded in the System Control and Receiving Station (SCARS) format on the Communications Interface System (CIS) during August. The down-converter (a device that reduces transmission frequency) of the satellite receiver failed early in July and was not repaired until September. During the last two weeks of October, RSTN data were recorded on 57 backup tapes in the SCARS format.

Several INGRES databases were developed. They are:

EXPLOSION – a list of shots from the Network Test Site (NTS) containing location, elevation, depth of burial, media, yield, date and time, etc.

EVENTS – earthquake bulletins of the National Earthquake Information Service (NEIS) listing event date and time, location, geographic and seismic

region numbers, magnitude, depth, detected phases at each station, and additional related information.

ARCHIVE – the waveforms which include 100% of the long-period data and short-period segments when the station has detected a signal.

IDCE – waveform data as contributed by the USA from 20 stations to the International Data Center Experiments (IDCE) data set recorded during the first two weeks in October 1980. For this data set, planned for the IDCE, the stations were recording continuous short-period data rather than detector-triggered segments.

For six days in mid-January, signals were detected on the real-time RSTN channels, and arrival messages were formatted and transmitted over the Worldwide Meteorological Organization (WMO) network. All arrivals received over the WMO (as well as the RSTN's) were used to form an automatically associated event bulletin. This experiment was conducted to test and evaluate procedures and capabilities at the Center to participate in an international seismic data exchange experiment planned for later in the year.

Early in the contract period, the emphasis at the Center was on building databases and archiving the SRO/GDSN day tapes in the new Center archive format. Since the archiving was proceeding slowly, the routine processing of RSTN data (signal collection) and automatic association/bulletin preparation was halted so that one VAX was free for archiving on both day and evening shifts.

The attached table provides statistics about the uptime and detections of the RSTN stations and the arrivals that were included in the Center databases from Canadian seismic network, NEIS, WMO, and the Yellowknife Array (YKA) in Canada, and from the United Kingdom (UK) for their other arrays.

SYSTEM UPGRADES

Software was installed for the Terminal Interface Units (TIU). The TIU's allow a user to connect directly to the Proteon local computer network and thereby log onto any of the computers rather than having his terminal hardwired to one specific host computer. At the end of the report period there were nine Center terminals connected to TIU ports. All of the TIU terminal connections are at 9600 baud for better system response; however, the local computer network cannot be reached at this rate by dial-in lines. It was planned that a modified version of the TIU software be installed which would allow terminal connections at a variety of baud rates.

A third VAX 11/780 computer was moved to the Center from the Seismic Data Analysis Center in Alexandria, Virginia.

The satellite antenna downconverter was returned after repair by Motorola and reinstalled; however, there were problems with the unit, causing the system to occasionally miss blocks of data.

A 9.6KB line to Reston, Virginia, was installed in February. This enabled researchers at S-CUBED to access the systems and data at the Center.

A vertical long-period seismometer (Geotech SL-210) was installed in the basement of the Center. Its output was displayed on a portacorder in the lobby.

We installed Graphnet's Freedom Network Service on one of the VAX computers. This service enables any computer to act as a TWX and Telex terminal.

SOFTWARE DEVELOPMENT

A commercial version of the INGRES database management system was installed. We acquired this system on a trial basis from the vendor, Relational Technology Inc. The advantages of the commercial version over the university (Berkeley) version of INGRES are that it is supported (bugs are fixed and enhancements added by the vendor), it is better documented, and according to our initial experience, it provides faster throughput.

In November we completed the benchmark tests comparing the performance of the commercial version of INGRES to the version developed by the University of California at Berkeley. For reorganizing seismic waveform files by date, the commercial INGRES is slightly more than twice as fast as the university version. For seismic searches through databases of listed events and associated signal arrivals, the commercial version is 60 times faster. Searches which take hours on the university version take minutes on the commercial version. Since such searches are essential to the research at the Center, we decided to buy the commercial version of INGRES.

A control system was established for official application software. Initially the only programs are those used in data acquisition, in storage and retrieval of incoming data, and in routine signal analysis. The controls cover reporting and logging of software bugs, benchmark testing of bug fixes, and installation authorization for revised and new programs.

The database structure was revised in June so that specifically defined null values can be entered to distinguish them from blanks, which indicate that a parameter was not reported.

The procedure for reporting problems is handled by a bug report system administered by the Software Librarian. The programs that were revised and installed in a directory on one of the VAX's were:

AA (Automatic Association) – a program which generates a seismic bulletin from seismic detections,

DP (Detection Processor) – a program which detects signals on seismic data channels.

LOGTAP – a program which logs the archive tapes into the database library,

REAP – a program which removes duplicates from any alphanumeric list, and

WDISP – a program which allows viewing seismic waveforms on the Tektronix display.

All of these programs are used in routine data acquisition and signal analysis.

Programs revised and installed in the Center controlled software directory during this contract period included:

CPOUT – copy out, a program which searches INGRES databases and creates external files with the parameters specified by the user, and

GATHER – a program which receives waveform data into the database computer from the CIS over the local computer network and reformats the data in preparation for writing archive tapes.

These programs are used in routine data acquisition and database retrieval.

CONCLUSION

The objectives of routine operation for de-bug and system evaluation purposes were met by:

- real-time recording and analysis of the RSTN stations,
- adding data from the SRO and GDSN to the Center's databases, and
- routinely receiving and cataloging NEIS, WMO, CANADA, UK and YKA data.

System integration and evaluation provided:

- a local area network,

- an additional VAX,
- commercial expansion and enhancements, and
- an improved database system.

TABLE I

RSTN UPTIME IN HOURS
1983-1984

	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN
RSCP	625.5	606.9	598.4									
RSNT	576.2	151.7*	190.8*									
RSNY	613.8	606.7	683.5									
RSON	626.3	612.3	687.7									
RSSD	626.3	613.5	687.7									
MAX HRS.	672	744	720									
# OF TAPES	101	87	93									

* Instrument inoperable

RSTN DETECTIONS
1983-1984

	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN
RSCP	5146	4603	5269	3841								
RSNT	4214	510	985	1312								
RSNY	2928	3820	3010	2557								
RSON	3883	3643	3585	2826								
RSSD	4544	3757	3768	2383								

OUTSIDE ARRIVALS
1983-1984

	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN
CANADA	1662	2561	2416	1642	2722	2821	1286	885	1349	1064	1767	2142
NEIS	12393	15431	10829	12969	15349	7511	10787	10461	12401	11370	11184	12972
UK	1507	1742	1449	1363	1155	1639	508	1140	920	1243	1034	1771
WMO	3930	5523	5270	5225	6530	5945	5581	5152	5328	4534	5582	5374
YKA	852	906	1004	480	603	640	260	169	88	91	858	574

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